TCT-679

Underestimation of effective aortic orifice area after TAVR due to LVOT ellipticity and Impact on patient-prosthesis mismatch classification: What are we measuring?

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Background: Following transcatheter aortic valve replacement (TAVR), the presence of PPM has been reported in up to one third of patients. We sought to define the influence of left ventricular outflow tract (LVOT) geometry on calculation of the effective orifice area (eOA) and classification of patient-prosthesis mismatch (PPM) after TAVR.
Methods: 86 patients status post TAVR underwent both transthoracic echocardiography and contrast enhanced computed tomography. LVOT dimensions were assessed by means of planimetry on systolic CT reconstructions with subsequent calculation of an area-derived LVOT diameter. EOA was calculated according to the continuity equation, based on transaortic measurements by continuous-wave Doppler and LVOT measurements obtained by pulsed-wave Doppler (EOATTE). In addition, a modified EOA was calculated using the area-based LVOT diameter by CT (EOACT). Moderate and severe PPM were defined as an indexed EOA (iEOA) 0.85 cm2/m2 and 0.65 cm2/m2, respectively.
Results: Mean LVOT diameters were 2.4±0.3mm by TTE and 2.0±0.2mm by CT ($p< 0.001$). Mean EOATTE was significantly lower (1.7±0.4cm2) than EOACT (2.4±0.7cm2, $p< 0.001$). By iEOATTE, 20 patients (29%) were graded as moderate PPM and 4 (6%) as severe PPM. By iEOACT, PPM grade was reclassified in 21 patients, with 4 patients (6%) graded as moderate PPM and no patients (0%) graded as severe PPM.
Conclusions: Cardiac computed tomography measures of the IEOA results in significant reclassification of the PPM grade. Future investigation is needed to determine whether MDCT derived measurements of iEOA will serve as a more appropriate measure of PPM and correlate more closely with downstream clinical outcomes.

TCT-680

Influence Of Preoperative Computed Tomography Image Analysis By A Dedicated Software On Outcomes After Transcatheter Aortic Valve Implantation

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Background: Preoperative CT image analysis by a dedicated software has become part of the standard diagnostic work up in many TAVI centers. The aim of this analysis was to investigate the influence of preoperative MDCT analysis by a dedicated software on outcomes after TAVI.
Methods: 186 patients who underwent TAVI before introduction of a dedicated image analysis software at our institution were investigated. Preoperative CT scans of these patients were analyzed with the 3mensio® Medical Imaging software a posteriori in a blinded fashion. Based on these new measures, the best prosthesis size to be implanted was determined and compared to the valve sizes that were actually implanted.
Results: In 130 patients (69.9%/group A), valve sizing with 3mensio® led to recommendation of the same valve size that was actually implanted. However, in 29 patients (15.6%/group B), image analysis recommended a larger valve size and a smaller prosthesis in 19 patients (14.5%/group C). Group B showed a seven-fold higher rate of aortic regurgitation (AR) ≥2 compared to group A (20.7% vs. 3.2%, $p=0.001$) whereas group C did not show an elevated risk for conduction disturbances or annular ruptures. There was no difference in 1-year-mortality in all 3 groups.
Conclusions: Retrospective image analysis of preoperative MDCT scans by a dedicated software revealed a different valve size in about one third of the patients. Undersized patients had a seven-fold higher rate of AR ≥ 2 but this did not translate into a reduced 1 year survival.

TCT-681

Finite Element Analyses Stent and Leaflet Stresses on 26mm Transcatheter Aortic Valve

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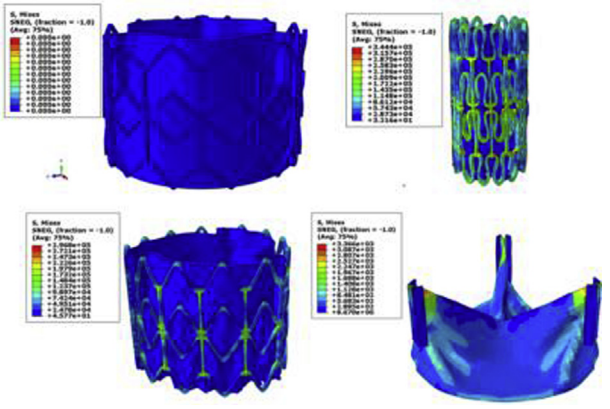
Background: Transcatheter aortic valves (TAV) have revolutionized treatment of severe aortic stenosis in high-risk and inoperable patients. Concern still exists regarding TAV durability, which depends upon design features of the stent, leaflets, Dacron, and suture connections. We previously performed finite element analyses (FEA) of a simplified TAV model of Edwards Sapien; however to date, no detailed FEA have been published using all the design features. The goal of this study was to determine stent and leaflet stresses using exact geometry.
Methods: Edwards Sapien 26mm(Edwards Lifesciences, Inc) was obtained and underwent microCT scanning. DICOM images and direct TAV measurements were used to create a precise model with stent, leaflets, Dacron, and suture. FE mesh was generated and simulations were performed using ABAQUS to model crimping, balloon-expansion, and recoiling of TAV, and leaflet loading to 80mmHg.
Results: Maximum VonMises stresses on TAV stent after crimping and ballooning were 344MPa and 296MPa, respectively (Figure 1); the plastic strain developed in the stent hinges was 10.3%. Peak VonMises stresses for TAV leaflets were 3.29MPa (crimping) and 2.14MPa (ballooning). Peak leaflet stress at 80mmHg was 3.33 MPa.



Conclusions: We performed FEA of 26mm Edwards Sapien incorporating precise stent, leaflet, Dacron, and suture features. Crimping yielded greater stresses on the stent and leaflets than ballooning. TAV leaflet stresses here can be compared with that obtained from surgical bioprostheses to assess impact of TAV design on durability.

TCT-682

Clinical Advantage Of Adjunctive Intracardiac Echocardiography In Angiography-Guided Transcatheter Aortic Valve Implantation

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Background: Improvements in experience and procedural safety have set the stage for a minimalistic approach to transcatheter aortic valve implantation (TAVI), which is characterized by angiographic guidance only, discarding routine intra-procedural echocardiography. However, angiography alone may provide insufficient diagnostic information in case of unaccounted events. Intracardiac echocardiography (ICE) allows continuous monitoring of all cardiac structures involved in TAVI, without interfering with angiography or requiring anesthetics.